The Biology of Two African Melittid Bees (Hymenoptera, Apoidea)

Jerome G. Rozen, Jr.[1]

Received for Publication October 18, 1973

INTRODUCTION

In terms of anatomical structures of both larvae and adults, bees belonging to the Melittidae are diverse even though the family is small. We do not know if this diversity is also revealed in their life histories because their biology has been little studied. I present the following with the hope that it will augment what is already known about their biology and that it will lead eventually to a better understanding of the phylogeny of the family.

These observations were made on a trip in October, 1972, to the Western Cape Region of the Republic of South Africa. Although three of the four subfamilies of melittids (Melittinae, Dasypodinae, and Ctenoplectrinae) occur in southern Africa, these notes refer only to two species in the Dasypodinae, *Capicola braunsiana* and *Haplomelitta ogilviei*. Adults of *Melitta capensis* Friese (Melittinae) were also seen but nests could not be located. This species mimics *Apis mellifera* Linnaeus to a remarkable extent as do species of a number of other genera of African bees. Ctenoplectrinae apparently do not occur in the arid regions where my observations were carried out. Mature larvae of *Capicola braunsiana* were described in a separate paper by Rozen and McGinley (in press). Adults and immatures collected in connection with this study are deposited in The American Museum of Natural History.

My studies were greatly assisted by Dr. F. Christian Thompson and Mr. Ronald J. McGinley whose companionship I enjoyed on the trip. Dr. Gerald I. Stage, University of Connecticut, Storrs, aided in the identification of adult bees. The research was supported by National Science Foundation Grant GB32193.

Capicola braunsiana Friese

This species was found nesting at 67 km. east of Port Nolloth, Cape Province, Republic of South Africa, on October 17, 1972, by Dr. Thompson. He and Mr. McGinley assisted me in the excavation of the site between 2 and 5 P.M. on the same day, which was clear and sunny. The nesting area (Fig. 1) was in a sandy, treeless region with low hills and numerous widely spaced

[1] Deputy Director for Research and Curator of Hymenoptera, The American Museum of Natural History, Central Park West at 79th Street, New York, New York 10024

Abstract: This paper treats the nesting biology of *Capicola braunsiana* Friese and *Haplomelitta ogilviei* (Cockerell) (Melittidae, Dasypodinae) from Cape Province, Republic of South Africa.

Fig. 1. Nesting site of *Capicola braunsiana*, 67 kilometers east of Port Nolloth, Cape Province, Republic of South Africa. Large-leafed vegetation is pollen plant.

Fig. 2. Nesting site of *Haplomelitta ogilviei*, 28 kilometers east of Velddrif, Cape Province, Republic of South Africa. Dr. F. Christian Thompson is peering into excavation of nest.

desert plants, most conspicuously succulents belonging to the *Mesembryanthemum, sensu lato,* (Aizoaceae). The gently sloping nesting site, covering an area of approximately two meters square, was mostly barren sand with a few plants including the pollen plant, a large, unidentified species of *Mesembryanthemum*; none of the plants shaded the nesting site appreciably. Dry loose sand mixed with some gravel and a few stones on the surface, the soil was more consolidated below the surface and became moist at a depth of about 12 cm. No other species of bee was seen burrowing at the site during the course of the brief observations but a nest of an halictid, probably *Dialictus,* was uncovered.

Nesting Activity: Although time did not permit an accurate counting, at least seven nests were definitely identified and other female bees flying around suggested that additional nests—perhaps a total of ten to fifteen—were present within the two-meter-square area. About half the nest entrances were adjacent to or under small stones on the surface of the ground, and the other entrances were in the open. Tumuli were observed around some of the entrances but in most cases excavated material apparently was quickly blown away.

The following information was obtained from excavating two nests (Figs. 3, 4). In each case the main tunnel, open at the surface, descended obliquely with considerable meandering to a depth of about 13 to 15 cm. The average rate of descent was somewhat less than 45 degrees from the horizontal. The main tunnel, 3.0 mm. in diameter, seemed to be clogged with soil at various intervals along the way but had some open spaces between and apparently was open more below than near the surface. Its wall was smooth and without a special lining. In one nest (Fig. 3), the tunnel, after reaching a depth of about 13 cm., gave rise to a linear series of four cells, each containing a mature larva. The tunnel then turned sharply and extended for 13 cm. in a unidirectional but somewhat meandering fashion, dropping only about 2 cm. over that length. It ended in an open cell containing a fully formed pollen ball. In the other nest (Fig. 4) the tunnel ended in a linear series of three cells as soon as it reached a depth of 14.5 cm. The cell closest to the tunnel was open and unprovisioned; the other two contained pollen masses and eggs. In a third nest, more hastily excavated than the other two, the main tunnel ran in meandering fashion downward to a depth of 14 cm., over a distance of about 32 cm., and ended in a linear sequence of three cells; the cell closest to the tunnel was open, the second was closed and contained a pollen ball and presumably an egg, and the third contained a pollen ball and an egg.

Hence, except for the single terminal cell in the first nest, all cells seemed to be arranged in a linear series. In the first nest cells in series were separated by a distance of 1.5 to 2.0 mm. Cells from all nests ranged in maximum length from 7.0 to 7.5 mm. (five measurements) and in maximum diameter from

4.5 to 5.0 mm. (five measurements). They were broadly rounded at the rear and more narrowed in front. Their long axis tilted from 30 degrees to 45 degrees from the horizontal and the anterior end was higher. Although cell walls appeared to be unlined, having a dull finish, a droplet of water placed upon the floor showed that it was waterproof while the upper part of the wall, similarly treated, only retarded absorption. Closures were concave on the inside with at best an indistinct spiral.

Only a single adult female was associated with each nest. However, the first nest consisted of a newly provisioned cell and four cells each with a mature larva. As the female associated with the nest was fresh, she was presumably not the parent of the larvae. Perhaps the nest had been occupied previously by another female.

Provisioning: The pollen plant grew profusely in the general area and was found on the nesting site itself (Fig. 1). The bee however apparently visits a number of species of *Mesembryanthemum* as it had been taken elsewhere, on other plants. The flowers of the pollen plant opened about 2 P.M. The female transported the pollen dry to the nest and there formed it into a perfect sphere, which was 2.5 to 2.9 mm. (three measurements) in diameter, mealy-moist throughout, pale green in color, and emitted no detectable odor.

Development: Several strongly curved eggs, translucent white with a shiny chorion, were each found on top of the pollen sphere in the longitudinal vertical plane of the cell. They were oriented with their anterior end toward the front of the cell. Their anterior and posterior ends were attached to the pollen mass while the middle looped upward. Two eggs measured 1.8 to 2.0 mm. in length and one was 0.45 mm. maximum diameter.

No feeding larvae were found but the four predefecating mature larvae from the first nest were oriented so that their posterior ends were at the rear of the cells. Each started defecating within a few hours of being brought in from the field. The feces are probably deposited, at least in part and perhaps entirely, toward the rear of the cell. All had completed defecation by October 22, 1972, at which time pupal features could be seen through the larval integument. This fact indicates either that the species has a number of generations per year or that unlike *Melitta, Macropis, Dasypoda,* and *Hesperapis* it overwinters as an adult rather than as a postdefecating larva. The larva closest to the burrow was male, the farthest female; the sex of the other two is unknown.

No parasitic bees were found in the vicinity of the nesting site.

Haplomelitta ogilviei (Cockerell)

This species was located first on October 15, 1972, at 28 km. east of Velddrif, Cape Province, Republic of South Africa. At that time the season was

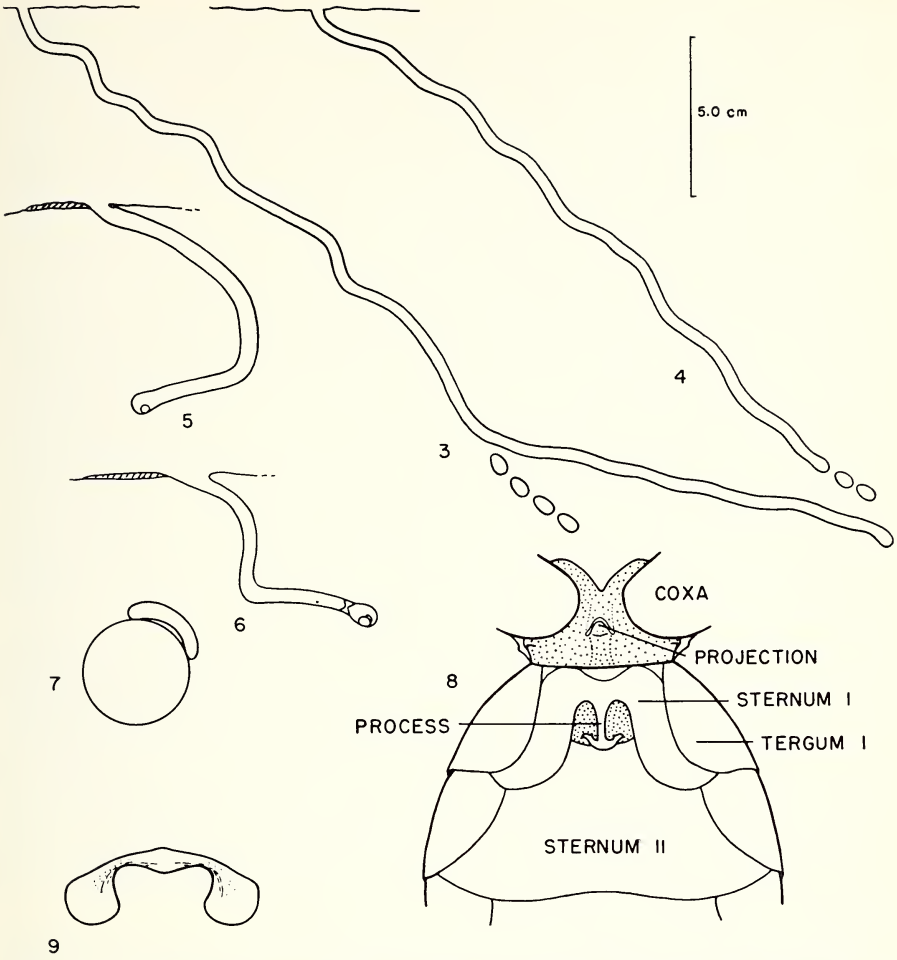
early in that neither the bees nor their pollen flowers were numerous. Consequently the area was revisited on October 23, when the following observations were made.

The site was in an extensive sandy region, the "Sandvelt," that extends from the mountains to the Atlantic coast. There is sufficient moisture for wheat farming and the site had been rained on the day prior to my excavations. The original vegetation was probably a semiarid scrub, although now the surrounding area is wheatlands. The nesting site and also the pollen plant (Fig. 2) occurred along the sides of a paved road, where the ground surface was flat, sandy, and covered with low herbs, including a very common yellow-flowered composite and the rather rare purple-flowered *Monopsis simplex* (Linnaeus) E. Wimmer, the pollen source of *Haplomelitta ogilviei*. Only two nests were found; neither was shaded by the vegetation. The soil immediately below the surface was moist because of the rain the previous day. The bee fauna of the area was abundant, with *Capicola, Scrapter*, halictids, and associated parasitic bees fairly common.

Nesting Activity: The two nest entrances were widely separated, one among the pollen plants that grew most abundantly on the south side of the road and the other 65 to 70 m. away on the north side. Neither entrance was associated with an object, such as a stone or twig, and both entered the ground obliquely where it was level. The low tumulus, 2.0 to 3.0 cm. in diameter, was to one side of the entrance, the side away from the descending tunnel.

In each nest (Figs. 5, 6) the main tunnel was open, extending at first obliquely downward and then descending nearly vertically. It was circular in cross section on one nest 5.0 mm. in diameter, and on the other varying from 4.0 to 5.0 mm. in diameter. Both tunnels ended in single cells. In the first nest excavated, the cell was open; in the other, closed. In each nest the diameter of the tunnel immediately before the open cell was 4.0 mm. in diameter, somewhat less than the remaining burrow and the terminal 3 cm. of the tunnel descended only very slightly. The cells were very shallow, being 4 and 6 cm. in depth. Both tilted from the horizontal by about 30 degrees and had their anterior ends higher. They were comparatively short (7.0 and 8.0 mm. long) in relation to width (6.0 mm.). Although without a visible lining, the cell wall was somewhat waterproof when tested with a droplet of water and the wall was slightly more rigid than the surrounding soil, an indication that the female had applied some substance that had permeated the soil. The cell closure was a partition of soil (mostly sand), evenly concave on the outside. On the inside no spiral could be detected, the closure seeming to consist of a single ring. The thickness of the closure at its middle was 1.0 to 1.5 mm.; at the periphery, approximately 3.0 mm.

This species may normally construct only a single cell to the nest because



Figs. 3, 4. Highly diagrammatic representation of two nests of *Capicola braunsiana.*

Figs. 5, 6. Semidiagrammatic representation of the nests of *Haplomelitta ogilviei* showing contents of cells. These illustrations are more precise than Figs. 3 and 4.

Fig. 7. Pollen ball and egg of *Haplomelitta ogilviei.*

Fig. 8. Posterior edge of mesosoma and base of metasoma of female of *Haplomelitta ogilviei,* ventral view.

Fig. 9. Apex of median process of metasomal sternum I of female of *Haplomelitta ogilviei,* posterior view.

(1) the cells were very shallow; (2) each nest had only a single cell; (3) the wings of the females from the nest were frayed (suggesting they had been active for a considerable period); and (4) the female of the second nest, after closing the cell, departed without first constructing either another lateral or a cell immediately in front of the closed cell.

Provisioning: Females, when gathering pollen from the flowers of *Monopsis simplex*, flew from flower to flower until a sufficient quantity of pollen had been accumulated on their hind legs and then would depart for the nest. Both females seen entering nests did so without first searching for entrances. One female was followed for 65 to 70 m. on her return to the nest from the pollen flowers, a path that took her across the road. Although strong winds caused her to land occasionally, her general route was direct.

The open cell contained a pollen ball, 2.25 mm. in diameter, which was spherical and of the same mealy-moist consistency as the provisions in the other nest. Its small size and the fact that the cell was still open indicated that it was a preliminary deposit of food. This species and certain panurgines (including *Nomadopsis*, *Calliopsis*, and most *Perdita*) are the only bees known to me to shape preliminary provisions. The female removed the pollen from her legs, shaped the sphere, and departed from the nest during a period of from one to two minutes. The other cell contained a complete pale grayish yellow pollen ball, 3.25 mm. in diameter, spherical, and evenly mealy-moist, which was not coated with a waterproof substance. The female finished adding to and shaping the provisions, deposited an egg, and closed the cell during a period of approximately one half-hour.

Development: The egg (Fig. 7), approximately 2.4 mm. long and 0.5 mm. wide at maximum diameter, was elongate, curved, translucent white, and with a shiny chorion. Its anterior end was blunter than the posterior and it was attached to the pollen sphere by its ends, whereas the middle part did not touch the food. The anterior tip of the egg was at the top of the pollen mass (Fig. 7) and the rest of the egg was to the rear of the pollen ball. Although in general its long axis was in the vertical longitudinal plane of the cell, the egg curved slightly toward the rear as seen from above, a situation that probably was atypical.

Cycles of Activity: The nests of the species were studied on a cool day that was partly cloudy in the morning but cleared toward noon. No adults were flying at 11:00 A.M., the first males were observed around noontime, and the females became active at about 1:30 P.M. Activity decreased after 3 P.M., perhaps because the weather again turned cool and partly cloudy. Adults were quite active during the early afternoon when the site was first discovered on October 15. Although the above observations are obviously incomplete, these bees may be active primarily during the early afternoon, a diurnal activity fairly common among other South African bees.

When active the males flew close to the ground from one flower of *Monopsis simplex* to another, and often rested on the ground or sat on the flowers. While on the flowers they lay motionless across the blossom, antennae erect, and head usually, if not always, at the edge of the corolla. On the ground, they

consistently rested with their hind legs spreading somewhat from their body in a stereotyped pose that males of most bees assume. The somewhat inflated hind basitarsus of the male may be a correlation with this posture. Because females entered the center of the flower head first they could be easily distinguished from males, which merely sat across the bellshaped flower. Because of their larger size and the fact that the hind legs were not slightly spread, females resting on the ground could be easily separated from males.

Females display a median projection (Fig. 8) on the ventral conjunctiva between the mesosoma and the metasoma. This projection is apparently associated with a peculiar modification of the first metasomal sternum which is deeply emarginate posteriorly and possesses a thin median process. The process expands slightly at the apex and gives rise to two ventrally directed, short, apically flattened branches (Fig. 9). No observations were made that explained the function of these adaptations.

Parasitism: Parasitic bees were not found in definite association with either nest. Although *Pseudodichroa*, *Sphecodopsis*, and *Sphecodes* were captured in the area, they seemed to be associated with solitary bees other than *Haplomelitta*. These parasitic bees and *H. ogilviei* have the same general body color pattern, i.e., pitch black head and mesosoma and a deep red metasoma with a black apex. The coloration seems to represent a wide-ranging mimetic color pattern especially common among South African parasitic bees as well as some nonparasitic forms.

Literature Cited

Rozen, Jerome G., Jr., and McGinley, Ronald J. Phylogeny and systematics of Melittidae based on the mature larvae (Insecta, Hymenoptera, Apoidea). Amer. Mus. Novitates. [In Press.]